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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/519,724

Filing Date: December 28, 2004

Appellant(s): LAERMER, FRANZ

Clifford A. Ulrich

For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 12/10/2010 appealing from the Office action mailed 06/30/2010.

(1) Real Party in Interest

The examiner has no comment on the statement, or lack of statement, identifying by name the real party in interest in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The following is a list of claims that are rejected and pending in the application:

Claims 14-31.

(4) Status of Amendments After Final

The examiner has no comment on the appellant's statement of the status of amendments after final rejection contained in the brief.

(5) Summary of Claimed Subject Matter

The examiner has no comment on the summary of claimed subject matter contained in the brief.

(6) Grounds of Rejection to be Reviewed on Appeal

The examiner has no comment on the appellant's statement of the grounds of rejection to be reviewed on appeal. Every ground of rejection set forth in the Office action from which the appeal is taken (as modified by any advisory actions) is being maintained by the examiner except for the grounds of rejection (if any) listed under the subheading "WITHDRAWN REJECTIONS." New grounds of rejection (if any) are provided under the subheading "NEW GROUNDS OF REJECTION."

(7) Claims Appendix

The examiner has no comment on the copy of the appealed claims contained in the Appendix to the appellant's brief.

(8) Evidence Relied Upon

3,354,646	WALTER ET AL	11-1967
20010007275	YANAGISAWA et al	07-2001
5,641,380	YAMAZAKI et al	06-1997
5,756,400	YE et al	05-1998
6,136,214	MORI et al	10-2000
6,953,557	IKEDA et al	10-2005

SUTO et al "Selective Etching of Si3N4 to SiO2 Employing Fluorine and Chlorine Atoms Generated by Microwave Discharge", J. Electrochem.Soc., Vol. 136, No. 7, July 1989

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 14, 16-22, 27, 29, 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Admitted prior art in view of Walter et al (US 3,354,646), Suto et al (NPL – Highly Selective Etching of Si₃N₄ to SiO₂ Employing Fluorine and Chlorine Atoms Generated by Microwave Discharge – J. Electrochem. Soc., Vol. 136, No. 7, July 1989) and Yanagisawa et al (US PG PUB No. 2001/0007275).

Regarding Claims 14, 16: Admitted prior art teach a method and apparatus that discloses benefit of using ClF₃ for etching silicon substrates (Applicant's specification – page 1, lines 10-20).

Admitted prior art does not teach a device for generating ClF₃ comprising: plasma generating means for generating a high density plasma in the plasma reactor, and also do not teach the gas supply means including a first mass flow regulator configured to regulate the first gas to a first flow rate to the plasma reactor, and

a second mass flow regulator configured to regulate the second gas to a second flow rate to the plasma reactor,

wherein the first flow regulator and the second flow regulator are configured to regulate the respective first and second flow rates to provide an ideal stoichiometric conversion of the first gas and the second gas to chlorine trifluoride.

Walter et al teach an apparatus for generating chlorine trifluoride using plasma glow discharge having spaced electrodes (which would obviously use a plasma reactor) using a first gas (F₂) and a second gas (Cl₂) which gases react with one another under the influence of plasma discharge to generate ClF₃ (besides ClF₅). Walter et al further teach that besides other factors, relative concentrations of fluorine and chlorine atoms are controlled to obtain glow discharge. Walter also teaches that formation of ClF₅ does take place when chlorine and fluorine atoms are excited together, irrespective of their relative concentrations (e.g. col. 1, line 40 to col. 4, line 55).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to regulate the process parameters like pressure and flow rates of first and second gases as taught by Walter et al in the apparatus of admitted prior art to obtain glow discharge and generate ClF₃ to obtain enhanced etching rate of substrates.

Walter et al do not teach plasma generating means generate high density plasma in the plasma reactor, and also do not explicitly teach the gas supply means including a first mass flow regulator configured to regulate the first gas to a first flow rate to the plasma reactor, and a second mass flow regulator configured to regulate the second gas to a second flow rate to the plasma reactor, wherein the first flow regulator and the second flow regulator are configured to

regulate the respective first and second flow rates to provide an ideal stoichiometric conversion of the first gas and the second gas to chlorine trifluoride.

Suto et al teach a microwave plasma (high density plasma) etching apparatus (shown in Figure 1) for processing wafers comprising a plasma reactor (quartz tube) with gas supply means including a first gas (NF₃) and a second gas (Cl₂) selected to react with the first gas under the influence of high density plasma, and the gases are supplied to the plasma generating chamber (quartz tube) for carrying out etching on a silicon wafer. Suto et al further teach that etching is based upon the microwave plasma generated species of fluorine and chlorine that are supplied to a reaction chamber via a gas outlet. Suto et al also teach that during plasma discharge, F and Cl atoms and inter-halogen FCl molecules are generated which are then transported into the reaction chamber (e.g. Fig. 1 and pages 2032-2034). Since Suto teaches production of interhalogen ClF during the process, few molecules of ClF₃ would also be produced during the process, considering the teaching of Walter et al that ClF₃ could be produced under glow discharge conditions. It would be obvious to generate ClF₃ in the apparatus of AAPA in view of Walter et al and Suto et al by controlling factors for producing glow discharge like pressure, rate of flow of gases as per teaching of Walter et al. Thus the apparatus of AAPA in view of Walter et al and Suto et al is considered capable of generating ClF₃ under high density plasma. It is noted that Suto et al uses similar gases viz. Cl₂ and NF₃ as also used by the applicant to produce ClF₃.

Further, the applicant has invoked 35 USC 112 sixth paragraph in respect of claim limitations a) "plasma generating means" as included in specification at page 11, lines 10-37 (including a microwave waveguide 150, magnetron 170, terminator 180, circulator 160, tuner 155).

Still further, claim limitation “gas supply means (21, 22, 25) -----to chlorine trifluoride” is not considered to invoke 35 USC 112 sixth paragraph since the limitation includes relevant structure, and thus does not meet prong “C” of the 3-prong analysis [MPEP 2181].

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to use high density plasma generation means as taught by Suto et al in the apparatus of admitted prior art in view of Walter et al to generate ClF_3 and obtain enhanced etching of silicon substrate.

Admitted prior art in view of Walter et al and Suto et al do not explicitly teach a) the plasma generating means include microwave waveguide 150, magnetron 170, terminator 180, circulator 160, tuner 155), and b) the gas supply means including a first mass flow regulator configured to regulate the first gas to a first flow rate to the plasma reactor, and

a second mass flow regulator configured to regulate the second gas to a second flow rate to the plasma reactor,

wherein the first flow regulator and the second flow regulator are configured to regulate the respective first and second flow rates to provide an ideal stoichiometric conversion of the first gas and the second gas to chlorine trifluoride.

Though Suto et al teach high density plasma generating means comprising of a microwave plasma apparatus but do not explicitly teach details of the same like waveguide, tuner, terminator etc. However use of microwave plasma apparatus for plasma etching and comprising waveguide, tuner, terminator etc and gas bottles and mass flow regulators is known in the art as per reference cited hereunder.

Yanagisawa et al teach a plasma apparatus (Figure 1) comprising:

A discharge tube 2 (plasma reactor) with plasma generating means (including magnetron 10, waveguide 11 (hollow conductor) with tuner 14, isolator (normally includes circulator) 15 and reflection plate (terminator) 13, by which plasma can be generated in the discharge tube 2 and gas supply means including gas bombs 31, 32, 33. Yanagisawa et al also teach gas flow regulators (controllers) 34, 35, 36 that can be adjusted to control flow rates of the first and the second gas supplied to the discharge tube 2 (plasma reactor), and reactive species generated due to reaction of two gases under high density plasma, are supplied to the process chamber via the gas pipe 20 at its outlet 20a (Fig. 1 and para. 0044-0053, 0072). It would be obvious to provide the plasma generating means of AAPA in view of Walter et al and Suto et al with items like waveguide tuner, terminator, circulator etc and the gas flow regulators for the first and the second gases as taught by Yanagisawa et al as known means for use in microwave plasma apparatus for generating high density microwave plasma. Further, since Walter et al teach that besides other factors, relative concentrations of fluorine and chlorine atoms are controlled to obtain glow discharge, and that formation of ClF₅ does take place when chlorine and fluorine atoms are excited together, irrespective of their relative concentrations, and still further that fluorine is present at least in stoichiometrical amounts for production of ClF₅ (including ClF₃) {e.g. col. 1, line 40 to col. 4, line 55}, it would be obvious to regulate flows of both fluorine and chlorine containing gases to obtain optimized (stoichiometric) conversion of these gases to form ClF₅. Further, since apparatus of Walter et al also generates ClF₃ (during generation of ClF₅) it would be obvious to regulate flow rates of first and second gases by the first and second gas flow regulators to obtain optimized stoichiometric conversion of these gases to ClF₃ and obtain increase etching rates of silicon substrates. Thus the prior art apparatus of Admitted prior art in

view of Walter et al, Suto et al Yanagisawa et al meets all the structural limitations of the claim, and is considered equivalent to the applicant's disclosed apparatus, and the same is considered capable of generating chlorine tri-fluoride as claimed (when the structure recited in the reference is substantially identical to that of the claims, claimed functions are presumed to be inherent – MPEP 2112.01) .

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to provide plasma generating means comprising items like tuner, terminator, circulator etc and the gas supply means comprising first and second gas flow regulators as taught by Yanagisawa et al in the apparatus of AAPA in view of Walter et al and Suto et al as known means for use in high density (microwave) plasma generating apparatus.

In this connection courts have ruled:

The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in Sinclair & Carroll Co. v. Interchemical Corp., 325 U.S. 327, 65 USPQ 297 (1945)

Additionally, claim limitations “device for generating chlorine trifluoride”, “to form chlorine trifluoride” and “formed chlorine trifluoride” are intended use limitation, and since the prior art apparatus meets all the structural limitations of the claim, the same is considered capable of meeting the intended use limitation.

In this connection courts have ruled:

A claim containing a “recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art

apparatus” if the prior art apparatus teaches all the structural limitations of the claim. Ex parte Masham, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987).

Regarding Claim 17: Suto et al teach the plasma reactor includes a quartz tube. Further, Yanagisawa et al teach the plasma reactor includes a tube 2 made from aluminum oxide (para. 0049).

Regarding Claim 18: Yanagisawa et al teach gas flow regulators (controllers) 34, 35, 36 which can be adjusted (configured) to adjust flow rates of first and second gases (para. 0050, 0072).

Regarding Claim 19: Admitted prior art in view of Walter et al, Suto et al and Yanagisawa et al teach all limitations of the claim (as already explained above under claim 14) including the apparatus having a process chamber with a wafer to be processed and connected to a plasma via a gas outlet, and where the wafer is exposed to the plasma species generated by the device (Suto et al – Fig. 1). Further, the substrate in the processing chamber of Suto et al (Fig. 1) would be exposed to the gas generated in the plasma generating chamber. Since the prior art apparatus of AAPA in view of Walter, Suto and Yanagisawa is considered capable of generating ClF₃ (as explained above under claim 14), the substrate in the processing chamber is exposed to ClF₃. Additionally since the prior art apparatus meets all the structural limitations of the claim, the same is considered capable of meeting the functional limitation “exposed to gaseous ClF₃”.

Regarding Claims 20-22, 27: Admitted prior art in view of Walter et al, Suto et al and Yanagisawa et al teach all limitations of the claim (as already explained above under claim 14) including a method wherein a first gas (e.g. NF₃) and a second gas (e.g. Cl₂) react with one

another under the influence of high density plasma (using microwave excitation) to produce CIF₃. Though Walter et al does not teach using high density plasma discharge for producing CIF₃ (besides producing CIF₅), Walter et al teach that besides other factors, relative flow rates of the two gases are controlled to obtain plasma discharge and obtain production of CIF₃ (besides CIF₅). Though Suto et al do not explicitly teach that the method produces chlorine trifluoride, but since Suto teaches production of interhalogen CIF during the process, few molecules of CIF₃ would also be produced during the process, considering the teaching of Walter et al that CIF₃ could be produced under glow discharge conditions. Further, since Walter et al teach that process factors like pressure and flow rates of two gases are controlled to obtain glow discharge and produce CIF₅, it would be obvious to regulate the flow of first and second gases to obtain optimized (stoichiometric) generation of CIF₅ (and CIF₃) [e.g. Suto et al - Fig. 1 and pages 2032-2034 and Walter et al – col. 3, lines 4-44].

Additionally since the prior art structure of Admitted prior art in view of Walter et al, Suto et al and Yanagisawa et al is equivalent to the applicant's claimed structure, and the claim does not recite any additional process conditions except the selection of relative gas flows, which is also taught by the prior art of Admitted prior art in view of Walter et al, Suto et al and Yanagisawa et al as already explained above, the prior art method teaches all limitations of claim 20 for generation of CIF₃ using high density plasma discharge and wherein the ratio of amounts of the two gases are selected to obtain an ideal stoichiometric conversion to CIF₃. Examiner also notes that Suto et al uses similar gases viz. Cl₂ and NF₃ as also used by the applicant to produce CIF₃.

Regarding Claims 29, 30: AAPA in view of Walter et al, Suto et al and Yanagisawa et al teach all limitations of the claim (as already explained above under claims 14, 20) including a method for generating chlorine trifluoride including comprising: generating a high-density plasma in a plasma reactor; supplying to the plasma reactor a first gas; supplying to the plasma reactor a second gas; reacting the first gas and the second gas under the influence of the high-density plasma to form chlorine trifluoride in the plasma reactor; transferring the formed chlorine trifluoride to a process chamber assigned to the plasma reactor; and etching a silicone substrate in the process chamber using the formed chlorine trifluoride as an etching gas. Further, AAPA in view of Walter et al, Suto et al and Yanagisawa et al also teach that amounts of fluorine and chlorine (i.e. the ratio of the amount of the first gas and the amount of second gas) are selected to obtain an optimized stoichiometric conversion to ClF_3 (Suto et al – Fig. 1 and pages 2032-2034, Walter et al – col. 3, lines 4-44 and Yanagisawa et al - Fig. 1 and para. 0044-0053, 0072).

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over AAPA in view of Walter et al (US 3,354,646), Suto et al (NPL – Highly Selective Etching of Si_3N_4 to SiO_2 Employing Fluorine and Chlorine Atoms Generated by Microwave Discharge – J. Electrochem. Soc., Vol. 136, No. 7, July 1989) and Yanagisawa et al (US PG PUB No. 2001/0007275) as applied to claims 14, 16-22, 27, 29, 30 and further in view of Ye et al (US 5,756,400).

Regarding Claim 15: AAPA in view of Walter et al, Suto et al and Yanagisawa et al teach all limitations of the claim including a method and apparatus using microwave plasma (high

density plasma) apparatus but do not teach the plasma generating means comprise a coil, matching network and a high frequency generator.

Use of a RF coil for generating a high density plasma is known in the art for plasma processing as per reference cited hereunder.

Ye et al teach a method for dry-clean etching of chamber internal surfaces, wherein a first gas (fluorine containing gas) and a second gas (chlorine containing gas) are introduced in a high density inductively coupled plasma reactor comprising a coil 40, matching network 30 and a high frequency generator 28 (e.g. Fig. 2 and col. 7, line 10 to col. 8, line 5 and col. 11, line 62 to col. 15, line 15).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to use the plasma generating means including a coil, a matching network and a RF generator as taught by Ye et al in the apparatus and method of AAPA in view of Walter et al, Suto et al and Yanagisawa et al as a known means of generating high density plasma for semiconductor wafer processing.

In this connection courts have ruled:

The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

Claims 23, 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over AAPA in view of Walter et al (US 3,354,646), Suto et al (NPL – Highly Selective Etching of Si₃N₄ to SiO₂ Employing Fluorine and Chlorine Atoms Generated by Microwave Discharge – J.

Electrochem. Soc., Vol. 136, No. 7, July 1989) and Yanagisawa et al (US PG PUB No. 2001/0007275) as applied to claims 14, 16-22, 27, 29, 30 and further in view of Mori et al (US 6,136,214).

Regarding Claim 23: AAPA in view of Walter et al, Suto et al and Yanagisawa et al teach all limitations of the claim except oxygen being supplied as an additional gas to plasma reactor or to the process chamber.

Mori et al teach a method for etching silicon oxide film on semiconductor substrates using ClF_3 as an etching gas and where oxygen was also supplied as an additional gas (col. 20, lines 5-18).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use oxygen as an additional gas supplied to the process chamber as taught by Mori et al in the apparatus of AAPA in view of Walter et al, Suto et al and Yanagisawa et al for enhancing selective etching of silicon oxide films (column 20, lines 30-38).

Regarding Claim 26: Mori et al teach the plasma density used for etching is around 10×10^{11} - 10×10^{12} particles/cm² (col. 7, lines 20-30).

Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over AAPA in view of Walter et al (US 3,354,646), Suto et al (NPL – Highly Selective Etching of Si_3N_4 to SiO_2 Employing Fluorine and Chlorine Atoms Generated by Microwave Discharge – J. Electrochem. Soc., Vol. 136, No. 7, July 1989) and Yanagisawa et al (US PG PUB No. 2001/0007275) as applied to claims 14, 16-22, 27, 29, 30 and further in view of Ikeda et al (US 6,953,557).

Regarding Claim 24: AAPA in view of Walter et al, Suto et al and Yanagisawa et al teach all limitations of the claim except a filter downstream from the plasma reactor for separating HF.

Ikeda et al teach a method where harmful gases like HF are removed from the etching gases like ClF_3 using a removing apparatus (like a filter). Further, these removing apparatus (like stirring tank 5) are installed down stream of the plasma reactor (exhaust line 1) [col.1, lines 15-35 and col. 4, lines 10-60].

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use filter for separating/treating gases like HF as taught by Ikeda et al in the apparatus of AAPA in view of Walter et al, Suto et al and Yanagisawa et al to separate out harmful components from the etching gases like ClF_3 .

Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over AAPA in view of Walter et al (US 3,354,646), Suto et al (NPL – Highly Selective Etching of Si_3N_4 to SiO_2 Employing Fluorine and Chlorine Atoms Generated by Microwave Discharge – J. Electrochem. Soc., Vol. 136, No. 7, July 1989) and Yanagisawa et al (US PG PUB No. 2001/0007275) as applied to claims 14, 16-22, 27, 29, 30 and further in view of Ye et al (US 5,756,400).

Regarding Claim 25: AAPA in view of Walter et al, Suto et al and Yanagisawa et al teach all limitations of the claim including supply of first gas and a second gas, and such that there is excess of fluorine, but do not teach that the fluoride atoms and chlorine atoms in the form of radicals or reactive species are present in the high density plasma at a 3: 1 ratio.

Ye et al teach a method for dry-clean etching of chamber internal surfaces, wherein a first gas (fluorine containing gas) and a second gas (chlorine containing gas) are introduced in a high density inductively coupled plasma reactor comprising a coil 40, matching network 30 and a high frequency generator 28. Ye et al further teach that fluorine containing gas should be at least 50 % or greater and the chlorine containing gas should be minimum of 10 % to about 50%, which meets the claimed ratio of 3:1 (e.g. Fig. 2 and col. 7, line 10 to col. 8, line 5 and col. 11, line 40 to col. 15, line 15).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to provide the fluoride atoms and chlorine atoms in the form of radicals or reactive species being present in the high density plasma at a 3: 1 ratio as taught by Ye et al in the apparatus and method of AAPA in view of Walter et al, Suto et al and Yanagisawa et al to enable form chlorine trifluoride.

Claims 28, 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over AAPA in view of Walter et al (US 3,354,646), Suto et al (NPL – Highly Selective Etching of Si₃N₄ to SiO₂ Employing Fluorine and Chlorine Atoms Generated by Microwave Discharge – J. Electrochem. Soc., Vol. 136, No. 7, July 1989) and Yanagisawa et al (US PG PUB No. 2001/0007275) as applied to claims 14, 16-22, 27, 29, 30 and further in view of Yamazaki et al (US 5,641,380).

Regarding Claims 28, 31: AAPA in view of Walter et al, Suto et al and Yanagisawa et al teach all limitations of the claim including that chlorine trifluoride is supplied to a process chamber 1 and that flow rates of first gas and the second gas are controlled to obtain an ideal

stoichiometric conversion to ClF_3 , but do not teach that the flow rate of chlorine trifluoride to the process chamber is greater than 100 sccm.

Yamazaki et al teach a method of etching a substrate in a process chamber wherein chlorine trifluoride is supplied at a flow rate of 500 sccm {col. 6, lines 15-25}. It would have been obvious to supply the chlorine trifluoride from the plasma reactor to the process chamber at a flow rate of 500 sccm (which meets the claim limitation of “greater than 100 sccm”) to enable etch a substrate.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to control the flow rate of chlorine trifluoride as taught by Yamazaki et al in the apparatus of AAPA in view of Walter et al, Suto et al and Yanagisawa et al to enable etch the substrate.

(10) Response to Argument

Rejection of Claims 14, 16 to 22, 27, 29, and 30 under 35 U.S.C. § 103(a)
over the combination of AAPA, Walter et al, Suto et al, and Yanagisawa et al.

Appellant argues that as regards the alleged inherency of chlorine trifluoride in the apparatus of Suto et al., the apparatus and base gases disclosed in Walter et al. differ substantially from the disclosure of Suto et al. Thus, the purported generation of chlorine trifluoride in Walter et al. does not in any way establish or support any contention that chlorine trifluoride would necessarily be generated under the conditions disclosed in Suto et al. Thus, the assertion of inherency is plainly deficient. See *In re Robertson*, 169 F.3d 743, 745, 49 U.S.P.Q.2d 1949, 1950-51 (Fed. Cir.1999).

Examiner responds that Walter teaches that CIF₃ could be produced under glow discharge using chlorine and fluorine containing gases. Walter also teaches controlling flow rate of gases, pressure etc to control glow discharge. Further, Suto et al also teaches a high density plasma apparatus using chlorine and fluorine containing gases like Cl₂ and NF₃, that generates inter-halogen molecules like CIF. Additionally, Yanagisawa et al teach gas supply means 31, 32, 33 with flow regulators 34, 35, 36 to enable supply adjusted flow rates of the gases to plasma reactor 2. It would be obvious to control pressure, flow rates of gases etc in the apparatus of AAPA in view of Walter, Suto and Yanagisawa in view of teaching of Walter, to obtain generation of CIF₃ under high density plasma discharge. Thus the apparatus of AAPA in view of Walter, Suto and Yanagisawa is considered capable of generating CIF₃.

Appellant further contends that the combination of references relied upon in the rejection, the he (the Appellant) disagrees with the Examiner's contention at page 8 of the Final Office Action that AAPA "teaches a method and apparatus that discloses benefit of using CIF₃ for etching silicon substrates." In this regard, the portion of the Specification (page 1, lines 10 to 20) cited by the Examiner does not disclose any apparatus. The Examiner argues at page 2 of the Advisory Action that the process described by AAPA would inherently utilize some form of apparatus. However, even if some apparatus would be required to practice the process disclosed by AAPA, there is no disclosure in AAPA of any structure whatsoever of the allegedly inherently disclosed apparatus. Thus, it is entirely unclear what features would be modified in view of the other cited references and how such modifications would be incorporated.

Examiner responds that the final office action (page 8) had indicated AAPA "teaches a method and apparatus that discloses benefit of using CIF₃ for etching silicon substrates" in the context of specification's teaching (page 1, lines 10-20) regarding benefit of using CIF₃ for etching silicon substrates, and considering that any process would necessarily require an apparatus to carry out the same.

Further, in response to appellant's arguments regarding Walter teaching only a single tank holding the gas composed of one or more substances, and thus any mention of stoichiometric proportions of fluorine and chlorine atoms necessarily referring to the proportion of these atoms present in the single source of reactant gas, examiner responds that Walter teaches of using stoichiometric amount of fluorine to enable production of CIF₅. Suto et al teaches using two gases viz. Cl₂ and NF₃. Further, Walter also teach that with the glow discharge, CIF₅ and other gases including CIF₃ could be continuously withdrawn from the apparatus (Walter - col. 1, lines 40-58). Additionally, since Suto teaches using two separately supplied gases Cl₂ and NF₃, it would be obvious to control the pressure, flow rate of each of the two gases, to obtain continuous supply of CIF₃. Further, one of skill in the art looking to obtain CIF₃ would obviously control flow rates etc of both the constituent gases to obtain stoichiometric conversion of the constituent gases to optimize the yield of CIF₃, in view of Walters's teaching of controlling stoichiometrically proportions of atoms to obtain optimum yield. Additionally, optimizing the gas flows etc to stoichiometric proportions to optimize the yield would be obvious to one of skill in the art. Thus the apparatus of AAPA in view of Walters and Suto is considered capable of producing CIF₃.

Appellant further contends that in Suto et al since the apparatus of Suto et al. is arranged such that a substantial portion of the atoms interact--after leaving the microwave tube--with either the silicon substrate or the separately introduced chlorine gas, there would be no apparent reason to provide the NF₃ and Cl₂ gas into the microwave tube in any particular stoichiometric ratio.

Further regarding Suto et al., Appellant disagrees with the assertion at page 10 of the Final Office Action that "since Suto teaches production of inter-halogen ClF during the process, few molecules of C1F₃ would also be produced during the process, considering the teaching of Walter et al. that C1F₃ could be produced under glow discharge conditions." Further to the discussion of inherency set forth above, whether or not chlorine trichloride "could" be produced in the apparatus of Walter does not in any way establish that chlorine trifluoride would necessarily be produced.

Examiner responds that Suto et al is cited regarding its teaching of using high density plasma to produce interhalogen molecules like ClF, using chlorine and fluorine containing gases. Suto et al also teach that interhalogen molecules like FCl are generated during the high density plasma generation in the discharge tube, which are then transported to the process chamber. Though Suto et al do not explicitly teach that the apparatus produces ClF₃, but few molecules of ClF₃ would be produced in the apparatus of AAPA in view of Walter and Suto et al, considering the teaching of Walter that ClF₃ is produced under glow discharge conditions. Further, since Suto et al teach using the generated interhalogen molecules in the process chamber for processing the substrate, it would be obvious to optimize the flow rate etc of the constituent gases to

stoichiometric proportions, in view of teachings of AAPA in view of Walter and Suto et al to obtain increased etching rate for processing of the substrate. Thus the apparatus of AAPA, Walter, Suto and Yanagisawa is considered capable of producing CIF₃.

Appellant further argues that even if Suto et al. disclosed the formation of some minute amount of chlorine trifluoride--which Suto et al. does not--there would still be no teaching or suggestion of etching a silicone substrate in the process chamber using the hypothetical chlorine trifluoride gas.

Yanagisawa et al also relates to converting gases into radicals that act directly on a substrate. See, e.g., para. [0004]. As was the case with Suto et al., there would be no apparent reason to provide the supply gases of Yanagisawa et al. into the microwave generator according to any particular stoichiometric ratio.

As indicated above, the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. does not disclose, or even suggest, a gas supply means including a first mass flow regulator configured to regulate the first gas to a first flow rate to the plasma reactor, and a second mass flow regulator configured to regulate the second gas to a second flow rate to the plasma reactor, wherein the first flow regulator and the second flow regulator are configured to regulate the respective first and second flow rates to provide an ideal stoichiometric conversion of the first gas and the second gas to chlorine trifluoride, as recited in claim 14.

Examiner responds that Suto does teach etching a silicon substrate (page 2032, left column under paragraph "Experimental". Further, as explained above, the apparatus of AAPA in view of Walter, Suto and Yanagisawa is considered capable of producing

ClF₃ (examiner notes that limitation "etching a silicon substrate" is a functional limitation for the apparatus of claim 14). Further, Yanagisawa teaches gas supply means 31, 32, 33 with flow regulators 34, 35, 36 to enable supply adjusted flow rates of the gases to plasma reactor 2. It would be obvious to regulate the supply of Cl₂ and NF₃ using flow regulators as taught by Yanagisawa in the apparatus of AAPA, Walter and Suto to provide an ideal stoichiometric conversion of the two gases to enable generate ClF₃ and enable etching substrate, in view of teaching of Walter that at least fluorine is supplied in stoichiometric quantity to generate ClF₅.

Appellant further argues that likewise, the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. do not disclose, or even suggest, supplying to a plasma reactor a first gas and a second gas, which react with one another under the influence of a high-density plasma in the plasma reactor, forming chlorine trifluoride, a ratio of the amount of the first gas and the amount of the second gas being selected to achieve an ideal stoichiometric conversion to chlorine trifluoride, as recited in claim 20.

Examiner responds that the Walter teaches generation of ClF₃ (besides ClF₅) {col. 3, lines 4-44} and that fluorine is present at least in stoichiometrical amounts for production of ClF₅ {e.g. col. 1, line 40 to col. 4, line 55}. Walter also teaches that generation of ClF₅ (and also ClF₃) takes place when chlorine and fluorine atoms are excited together, irrespective of their relative concentrations. It would be obvious to excite chlorine and fluorine atoms together to obtain optimized production of ClF₅ (and also ClF₃). Further since Yanagisawa teaches gas flow regulators 34-36, it would be obvious to control the amounts of both fluorine and chlorine (or regulate their flow rates)

to obtain an optimized or ideal stoichiometric conversion to obtain optimized stoichiometric conversion of these gases to ClF₃ and obtain benefit of increased etching rates of silicon substrates. Thus the combination of AAPA in view of Walter, Suto and Yanagisawa teach all limitations of claim 20 and claim 27, 29 as well as dependent claims 16-19, 21, 22 and 30.

Rejection of claims 15, 23-26, 28 and 31 under 35 USC 103 (a)

Appellant also argues that since the combination of AAPA, Walter, Suto and Yanagisawa does not render the independent claims 14, 20, 27 and 29 as unpatentable, the dependent claims 15, 23-26, 28 and 31 are also rendered non-obvious. patentable, since the additional references cited under rejection of the dependent claims 15, 23-26, 28 and 31 do not cure deficiency of AAPA, view of Walter, Suto and Yanagisawa pertaining to independent claims 14, 20, 27 and 29.

Examiner responds that as explained above and detailed under claim rejections, since claims 14, 20 and 27 and 29 are obvious over the combination of AAPA in view of Walter, Suto and Yanagisawa, the dependent claims 15, 23-26, 28 and 31 are also considered obvious as detailed under claim rejections.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/RAKESH DHINGRA/

Examiner, Art Unit 1716

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